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TR 67-31

AD815690

TECHNICAL REPORT NO. 67-31

OPERATION OF UBSO-QUARTERLY REPORT NO. 4

1 February 1967 through 30 April 1967

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GEOTECH

A TELEDYNE COMPANY

TECHNICAL REPORT NO. 67-31

OPERATION OF UBSO, QUARTERLY REPORT NO. 4
1 February 1967 through 30 April 1967

Sponsored by

Advanced Research Projects Agency
Nuclear Test Detection Office
ARPA Order No. 624

GEOTECH
A TELEDYNE COMPANY
3401 Shiloh Road
Garland, Texas

19 May 1967

IDENTIFICATION

AFTAC Project No:	VELA T/6705
Project Title:	Operation of UBSO
ARPA Order No:	624
ARPA Program Code No:	6F10
Name of Contractor:	Teledyne Industries, Geotech Division Garland, Texas
Date of Contract:	1 May 1966
Amount of Contract:	$624,897
Contract No:	AF 33(657)-16563
Contract Expiration Date:	31 October 1967
Program Manager:	B. B. Leichliter, BR 1-2561 Garland, Texas

ABSTRACT

This report describes the operation of the Uinta Basin Seismological Observatory (UBSO) from 1 February 1967 through 30 April 1967. Modifications and additions to the observatory instrumentation are described, and tests to improve the operations of the observatory are reported. Also discussed is the status of special investigations designed to evaluate and improve the detection capability of the observatory.

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OPERATION OF UBSO - QUARTERLY REPORT NO. 4
1 FEBRUARY 1967 THROUGH 30 APRIL 1967

1. INTRODUCTION

1.1 AUTHORITY

The work described in this report was supported by the Advanced Research Projects Agency, Nuclear Test Detection Office, and was monitored by the Air Force Technical Applications Center (AFTAC), under Contract AF 33(657)-16563. The statement of work for this contract is shown in the appendix.

1.2 HISTORY

The Uinta Basin Seismological Observatory (UBSO) was constructed under Contract AF 33(657)-7185. Site selection and noise surveys were accomplished by Geotech; the final decision on the observatory location was made by AFTAC. Texas Instruments Incorporated (TI) was responsible for the construction of all physical facilities.

Contract AF 33(600)-43486, issued to TI, contained the authority for equipping and operating UBSO. The instrumentation was supplied by Geotech and was installed under the direction of Geotech personnel under subcontract to TI. TI operated the observatory from November 1962 until 1 July 1963. Under Projects VT/1124 and VT/5054, Contract AF 33(657)-12373, Geotech operated UBSO from 1 July 1963 through 30 April 1966.

2. OPERATION OF UBSO

2.1 GENERAL

Data are recorded at UBSO on a 24-hour basis. The observatory is normally manned 8 to 10 hours a day, 5 days a week. On weekends and holidays, a skeleton crew mans the observatory 8 hours a day; however, additional personnel are on call in case of emergency.

The UBSO array configuration is shown in figure 1.

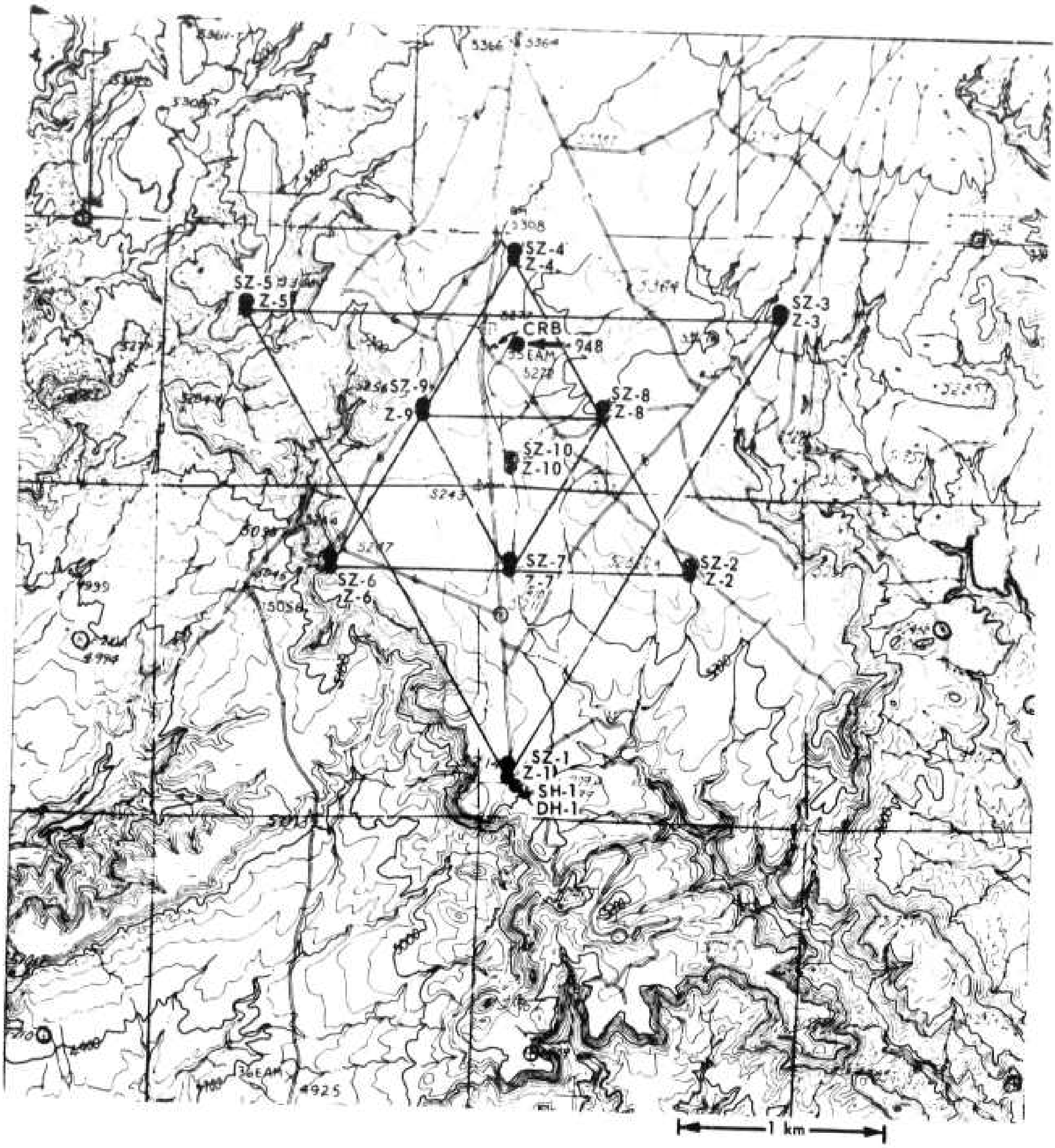

Figure 1. Orientation and configuration of UBSO arrays

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The Project Officer, Captain Frederick D. Munzlinger, visited Geotech's Garland office from 10 April through 12 April to discuss plans for work to be done under Project VT/6705. The UBSO Station Manager, Mr. Frank Seymour, was in Garland for these discussions.

2.2 SEISMOGRAPH OPERATING PARAMETERS

2.2.1 Standard Seismographs

The operating parameters and the tolerances for the standard observatory seismographs are shown in table 1. These parameters are reset, as necessary, when the frequency response of a seismograph is found to be out of tolerance. The frequency response norms and their respective tolerances are shown in table 2. The frequency responses of the UBSO seismographs, as normally operated are shown in figure 2.

2.2.2 Filters for Multichannel Array Processors (MAP)

All MAP channels utilize a band-pass filter with the following settings: a high-cut corner frequency of 3 cps at 6 dB per octave cutoff rate. and a low-cut corner frequency of 1 cps at 12 dB per octave cutoff rate.

2.2.3 Filters for Surface and Shallow-Buried Array Summations

Summations of the ten-element surface array and the ten-element shallow-buried array are each filtered by a band-pass filter with the following settings: A high-cut corner frequency of 3 cps and a low-cut corner frequency of 0.8 cps, both at a cutoff rate of 18 dB per octave.

2.2.4 Filters for Vertical Array Summations

The six elements of the vertical array are summed, and two outputs are recorded. Throughout the reporting period, one of the outputs (ΣDH) was operated as an unfiltered summation, and the second output (ΣDHF) was filtered by a band-pass filter with the following settings: a high-cut corner frequency of 3 cps at a cutoff rate of 24 dB per octave and a low-cut corner frequency of 0.75 cps at a cutoff rate of 36 dB per octave.

2.3 DATA CHANNEL ASSIGNMENTS

On 8 February, Data Group 5033 was established, replacing station time with the appropriate time-code data-management group identifier (TCDMG) on tape recorder 4. The current data-channel assignments and normal operating magnifications for all UBSO data groups are shown in table 3. The key to the designators used in the data-channel assignments is given in table 4.

Table 1. Operating parameters and tolerances of seismographs at UBSO

Seismograph		Seismometer		Operating parameters and tolerances					Filter settings	
System	Comp	Type	Model	T_s	λ_s	T_g	λ_g	σ^2	Bandpass at 3 dB cutoff (sec)	Cut off rate at SP side (dB/oct)
SP	Z and H	Johnson-Matheson	7515, 6480	1.25 ±2%	0.51 ±5%	0.33 ±5%	0.65 ±5%	0.03	0.1-100	12
SP	SZ	Geotech	18300	1.25 ±2%	0.51 ±5%	0.33 ±5%	0.65 ±5%	0.053	0.1-100	12
SP	Z	UA Benioff	1051	1.0 ±5%	1.0	0.083 ±5%	≈1.4	1.0	-	-
IB	Z	Melton	10012	2.5 ±5%	0.65 ±5%	0.64 ±5%	1.2 ±5%	0.018	0.05-100	12
IB	H	Geotech	8700B	2.5 ±5%	0.65 ±5%	0.64 ±5%	1.2 ±5%	0.001	0.05-100	12
BB	Z	Geotech	7505	12.5 ±5%	0.485 ±5%	0.64 ±5%	9.0 ±5%	0.0007	0.05-100	12
BB	H	Geotech	8700A	12.5 ±5%	0.485	0.64 ±5%	9.0 ±5%	0.0007	0.05-100	12
LP	Z	Geotech	7505A	20.0 ±5%	0.74 ±5%	110 ±10%	0.85 ±10%	0.63	25-1000	12
LP	H	Geotech	8700A	20.0 ±5%	0.74 ±5%	110 ±10%	0.85 ±10%	0.63	25-1000	12

KEY

SP	Short period	T_s	Seismometer free period (sec)
IB	Intermediate band (currently inactive)	T_g	Galvanometer free period (sec)
BB	Broad band	λ_s	Seismometer damping constant
LP	Long period	λ_g	Galvanometer damping constant
UA	Unamplified (i.e., earth powered)	σ^2	Coupling coefficient

Table 2. Calibration norms and operating tolerances for frequency responses of the standard seismographs at UBSO

SP Vertical 18300 and SP Johnson-Matheson Vertical and Horizontal

f (cps)	T (sec)	R. M.	A. T. (±%)
0.2	5.0	0.0113	10
0.4	2.5	0.0950	7.5
0.8	1.25	0.685	5
1.0	1.0	1.0	-
1.5	0.67	1.52	5
2.0	0.5	1.90	5
3.0	0.33	2.12	7.5
4.0	0.25	1.87	12
6.0	0.167	1.15	20
8.0	0.125		
10.0	0.100		

LP Vertical and Horizontal[c]

f (cps)	T (sec)	R. M.	A. T. (±%)
0.01	100	0.246	20
0.0125	80	0.377	20
0.0167	60	0.589	15
0.02	50	0.745	15
0.025	40	0.899	10
0.033	30	1.06	5
0.04	25	1.0	-
0.05	20	0.822	5
0.0667	15	0.506	10
0.10	10	0.173	20
0.143	7	b	a

IB Vertical and Horizontal

f (cps)	T (sec)	R. M.	A. T. (±%)
0.1	10.0	0.0090	25
0.2	5.0	0.068	20
0.3	3.3	0.25	15
0.4	2.5	0.46	10
0.5	2.0	0.64	5
0.7	1.43	0.86	5
1.0	1.0	1.0	-
1.5	0.67	1.04	5
2.0	0.5	1.0	10
3.0	0.33	0.89	15
5.0	0.2	0.66	20

BB Vertical and Horizontal

f (cps)	T (sec)	R. M.	A. T. (±%)
0.04	25.0	0.104	20
0.06	16.7	0.350	20
0.08	12.5	0.775	15
0.1	10.0	0.950	10
0.2	5.0	1.0	5
0.4	2.5	1.0	5
0.8	1.25	1.0	-
1.6	0.625	1.0	5
3.2	0.312	1.0	10
6.4	0.156	0.980	15

KEY

R. M.	Relative magnification
A. T.	Amplitude tolerance
a	Tolerance not established in the period
b	Measurements not reliable due to interference from microseismic background noise
c	These norms and tolerances apply to the broad-response, long-period system (LP1).

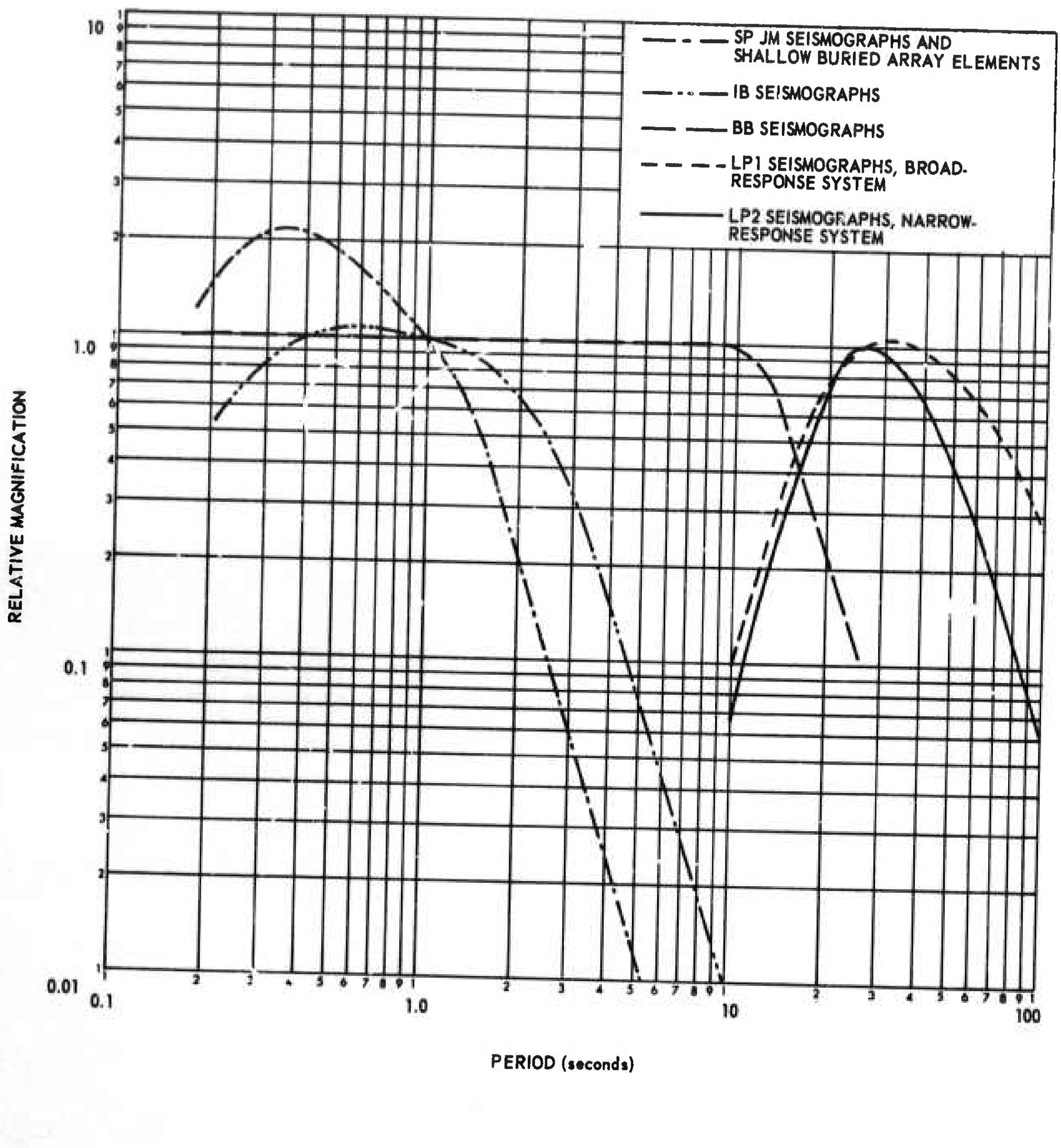

Figure 2. Normalized response characteristics of the standard seismographs at UBSO

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Table 3. Data channel assignments and normal operating magnifications at UBSO

DEVELOCORDERS

FAST SPEED 30mm/min.

DATA GROUP 5044 SP Primary

Channel	Trace	Mag.
1	V	20K
2	SZ1	600K
3	SZ3	600K
4	SZ5	600K
5	SZ2	600K
6	SZ4	600K
7	SZ6	600K
8	SZ7	600K
9	SZ8	600K
10	SZ9	600K
11	ΣSSF	6000K
12	ΣSS	1500K
13	SZ10	600K
14	NSP	600K
15	ESP	600K
16	WWV	---

DATA GROUP 5064

Channel	Trace	Mag.
1	V	2K
2	MS1	0.75μb/mm
3	MS2	0.75μb/mm
4	DH6	1000K
5	DH5	1000K
6	DH4	1000K
7	DH3	1000K
8	DH2	1000K
9	DH1	1000K
10	ΣDHF	6000K
11	ΣDH	1500K
12	SZ8	600K
13	USO-SP	---
14	USO-Time	---
15	WI	$\frac{3\text{ mph/mm}}{S=0/8\text{ mm }(E=6)}$
16	WWV	---

DATA GROUP 5068

Channel	Trace	Mag.
1	SZ10L	60K
2	NSPL	60K
3	ESPL	60K
4	Z10LL	5K
5	NSPLL	5K
6	ESPLL	5K
7	Z1	600K
8	Z3	600K
9	Z5	600K
10	ΣSF	6000K
11	ΣS	1500K
12	Z2	600K
13	Z6	600K
14	Z10	600K
15	TCMDG (Tape #1)	---
16	WWV	---

DATA GROUP 5070 MAP I

Channel	Trace	Mag.
1	Test	---
2	MCF4	Testing
3	MCF1	Testing
4	MCF3	Testing
5	BSS1	Testing
6	BSS2	Testing
7	BSS3	Testing
8	BSS4	Testing
9	BSS5	Testing
10	BSS6	Testing
11	ΣSBS	Testing
12	WWV	-----

DATA GROUP 5072 MAP II

Channel	Trace	Mag.
1	Test	---
2	MCF11	Testing
3	MCF12	Testing
4	MCF13	Testing
5	MCF14	Testing
6	MCF15	Testing
7	MCF16	Testing
8	MCF17	Testing
9	BSSV1	Testing
10	BSSV2	Testing
11	BSSV3	Testing
12	BSSV4	Testing
13	BSSV5	Testing
14	BSSV6	Testing
15	ΣDVS	Testing
16	WWV	-----

SLOW SPEED 3mm/min.

DATA GROUP 5066

Channel	Trace	Mag.
1	WI	$\frac{3\text{ mph/mm}}{S=0/8\text{ mm }(E=6)}$
2	SZ2	300K
3	ZLP1	25K
4	NLP1	25K
5	ELP1	25K
6	NLPS	20K
7	ZLP2	100K
8	NLP2	100K
9	ELP2	100K
10	ML1	3.0μb/mm
11	ML2	3.0μb/mm
12	USO-LP	---
13	ZBB	1.0K
14	NBB	1.0K
15	EBB	1.0K
16	WWV	----

MAGNETIC TAPE RECORDERS

Channel	DATA GROUP 5029 No. 1 Trace	DATA GROUP 5023 No. 2 Trace	DATA GROUP 5025 No. 3 Trace	DATA GROUP 5033 No. 4 Trace
1	TCDMG	TCDMG	TCDMG	TCDMG
2	DH1	ZBB	SZ1	USOZSP
3	DH2	NBB	SZ2	USOZLP
4	DH3	EBB	SZ3	USO Time
5	DH4	NSP	SZ4	ΣS
6	DH5	ESP	SZ5	ΣSSF
7	Comp.	Comp.	Comp.	Comp.
8	DH6	ZLP1	SZ6	MCF1
9	ΣDH	NLP1	SZ7	MCF3
10	ΣDHF	ELP1	SZ8	MCF4
11	Z10LL	ZLP2	SZ9	MCF11
12	NSPLL	NLP2	SZ10	MCF12
13	ESPLL	ELP2	ΣSS	MCF13
14	WWV & Voice	WWV & Voice	WWV & Voice	WWV & Voice

Table 4. Key to the designations used in the data format assignments at UBSO

Z	Amplified vertical short-period seismograph from a site identified by a suffix number	WI	Anemometer-wind speed and direction
NSP	Amplified north-south short-period seismograph	WWV	Radio time (WWV, STS, and voice on tape)
ESP	Amplified east-west short-period seismograph	ZBB	Vertical broad-band seismograph
V	Unamplified vertical short-period seismograph	NBB	North-south broad-band seismograph
ZLP1	Vertical long-period seismograph, broad response	EBB	East-west broad-band seismograph
NLP1	North-south long-period seismograph, broad response	ΣS	Summation of Z1 through Z10
ELP1	East-west long-period seismograph, broad response	ΣSF	ΣS filtered
ZLP2	Vertical long-period seismograph, narrow response	ΣSS	Summation of SZ1 through SZ10
NLP2	North-south long-period seismograph, narrow response	ΣSSF	ΣSS filtered
ELP2	East-west long-period seismograph, narrow response	DH1	Vertical-array element at 8895 feet
NLPS	North-south long-period seismograph, broad response (operated in surface tank)	DH2	Vertical-array element at 7903 feet
MS1	Short-period microbarograph (inside LP vault)	DH3	Vertical-array element at 6910 feet
MS2	Short-period microbarograph (outside LP vault)	DH4	Vertical-array element at 5894 feet
		DH5	Vertical-array element at 4901 feet
		DH6	Vertical-array element at 3907 feet
		ΣDH	Summation of DH1 through DH6

Table 4. Continued

ΣDHF	ΣDH filtered
ML1	Long-period microbarograph (inside LP vault)
ML2	Long-period microbarograph (outside LP vault)
MCF3	Multichannel filter: 8.1 ∞km/sec velocity signal and measured noise correlations (not including road noise) using Z1 - Z10
Test	Test instrumentation
Comp	Compensation
Mag	Magnification (see note)
TCMDG	Time code management data group
USO-SP	Unmanned seismological observatory short-period seismograph
USO-LP	Unmanned seismological observatory long-period seismograph
MCF1	Multichannel filter: ∞ velocity signal and measured noise correlations (not including road noise) using Z1 - Z10
MCF4	Multichannel filter: ∞ velocity signal and measured noise correlations (including road noise), using Z1 - Z10
MCF12	Multichannel filter: ∞ velocity signal and theoretical noise model using SZ1 - SZ10 and DH1 - DH6
MCF13	Multichannel filter: ∞ velocity signal and theoretical noise model using DH1 - DH6
MCF14	Deghost filter: up-going ∞ velocity P-wave signal and theoretical noise model using DH1, DH3, and DH5
MCF15	Deghost filter: down-going ∞ velocity P-wave signal and theoretical noise model using DH1, DH3, and DH5
BSS1	Beam-steered summation: 8.1 km/sec signal from azimuth of 0°, using Z1 - Z10
BSS2	Beam-steered summation: 8.1 km/sec signal from azimuth of 60°, using Z1 - Z10
BSS3	Beam-steered summation: 8.1 km/sec signal from azimuth of 120°, using Z1 - Z10
BSS4	Beam-steered summation: 8.1 km/sec signal from azimuth of 180°, using Z1 - Z10
BSS5	Beam-steered summation: 8.1 km/sec signal from azimuth of 240°, using Z1 - Z10

Table 4. Continued

BSS6	Beam-steered summation: 8.1 km/sec signal from azimuth of 300°, using Z1 - Z10	MCF16	Deghost filter: up-going ∞ velocity P-wave signal and theoretical noise model, using DH2, DH4, and DH6
ΣSBS	Summation of Z1 - Z10, with MAP band-pass filter	MCF17	Deghost filter: down-going ∞ velocity P-wave signal and theoretical noise model, using DH2, DH4, and DH6
MCF11	Multichannel filter: ∞ velocity signal and measured noise correlations (not including road noise), using SZ1 - SZ10	BSSV1	Beam-steered summation: up-going ∞ velocity P-wave using DH1 - DH6
BSSV2	Beam-steered summation: up-going 8.1 km/sec P-wave using DH1 - DH6	BSSV6	Beam-steered summation: down-going 8.1 km/sec S-wave, using DH1 - DH6
BSSV3	Beam-steered summation: up-going 8.1 km/sec S-wave, using DH1 - DH6	ΣDVS	Summation of SZ1 - SZ10 and DH1 - DH6, with MAP band-pass filter
BSSV4	Beam-steered summation: down-going ∞ velocity P-wave, using DH1 - DH6		
BSSV5	Beam-steered summation: down-going 8.1 km/sec P-wave, using DH1 - DH6		

NOTE

Magnification of:

Short-period measured at 1 cps
Broad-band measured at 0.8 cps
Long-period measured at 0.04 cps
MCF measured at 1 cps
BSS measured at 1 cps

2.4 DATA OUTAGES

On 29 March, 10 hours and 40 minutes of short-period primary data were lost because of a malfunctioning peristaltic pump in the Develocorder.

On 12 April, the Develocorder blower motor jammed, which opened the line power fuse to Develocorder 5, and resulted in a loss of approximately 11 hours of MAP II data.

2.5 COMMERCIAL POWER FAILURE

On 31 March. commercial power to UBSO failed for 40 minutes. All standby systems functioned normally during the power outage.

2.6 QUARTERLY PHOTOTUBE AMPLIFIER (PTA) LINEARITY AND GALVANOMETER DAMPING CHECKS

The quarterly PTA linearity and galvanometer damping checks were completed on 15 April. Any units found to be out of tolerance were adjusted to bring them within tolerance.

2.7 LIGHTNING STORM

A lightning storm occurred at UBSO on 19 March. Heavy spiking on DH6 was traced to a leaking spiral-four hock. The hock was dried and the system was returned to operation. On the same day, DH4 became inoperative because of a high-resistance short in the protector circuits at the wellhead. The data lines were transferred to a different circuit in the protector box and the system was returned to operation.

2.8 PLANNED CHANGE IN STATION PROCEDURE

In April, the following changes in UBSO routine operational procedures were recommended and approved by the Project Officer.

1330Z: Shut down and service secondary Develocorder. This Develocorder will be ready to record primary data by 1400Z.
Shut down, service, and return to operation, Develocorders 4, 5, and 6.

1400Z: Switch primary data to the standby Develocorder, then shut down and service the previous, primary Develocorder. When this Develocorder is in operation, switch secondary data to this camera.

1430Z: Begin routine daily calibrations. This new calibration schedule will not conflict with the calibration schedules of the other observatories.

All other station routines will remain unchanged. A typical 4-week work schedule is shown in table 5. Note that there will be two late analyst shifts and one late technician shift on Thursday, Friday, Saturday, and Sunday.

With this schedule, station personnel will be able to check the Develocorders for proper operation during the first 10 hours after film change. In addition, the analysts will have gains available for the first 14 hours of each run while reading the seismograms. The only disadvantage to the new procedure will be that two logs per run will be required for primary and secondary data, since any one run will be recorded partly on Develocorder 1 and partly on Develocorder 2.

We plan to begin the new schedule about 5 May.

2.9 SHIPMENT OF DATA TO THE SEISMIC DATA LABORATORY (SDL)

Magnetic-tape seismograms are shipped to SDL with the regular Long-Range Seismic Measurements (LRSM) Program data shipment about 15 days after the end of the month during which they were recorded. The seismograms from magnetic-tape recorders 1, 2, and 3 recorded at UBSO through 31 March and magnetic-tape recorder 4 seismograms recorded through 28 February have been shipped to SDL.

All 16-millimeter film seismograms recorded at UBSO through 31 January were sent to SDL. More recent films are currently held in Garland for special studies.

2.10 QUALITY CONTROL

Quality control checks were made on randomly selected runs of all recordings from the observatory. Results of the checks were sent to the observatory for corrective action as necessary.

Table 5. Planned 4-week work schedule

	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F
Tech A	E	E	E	E	E			E	E	E	E	E			L	L	E	E	E			L	L	E	E	E		
Tech B	L	L	E	E	E			L	L	E	E	E			E	E	E	E	E			E	E	E	E	E		
Tech C			E	E	E	E	E			E	E	E	E	E			L	L	L	L	L			L	L	L	L	L
Tech D			L	L	L	L	L			L	L	L	L	L			E	E	E	E	E			E	E	E	E	E
Analyst A			E	E	E	L	L			E	E	E	L	L			L	L	L	L	L			L	L	L	L	L
Analyst B			L	L	L	L	L			L	L	L	L	L			E	E	E	L	L			E	E	E	L	L
Analyst C	L	L	E	E	E			L	L	E	E	E			L	L	E	E	E			L	L	E	E	E		
Analyst D	L	L	E	E	E			L	L	E	E	E			L	L	E	E	E			L	L	E	E	E		
Sta. Manager			E	E	E	E	E			E	E	E	E	E			E	E	E	E	E			E	E	E	E	E

E: Early shift 1330Z - 2200Z 7:30 AM - 4:00 PM MDT

L: Late shift 1630Z - 0100Z 10:30 AM - 7:00 PM MDT

2.11 COOPERATION WITH THE LONG RANGE SEISMIC MEASUREMENTS (LRSM) PROGRAM

UBSO began sending copies of the daily message to Mr. Rudy Weisbrich, Geotech LRSM Group, on 10 April for use in conjunction with a special LRSM project.

2.12 SECURITY INSPECTION

Mr. William J. Robertson, Industrial Security Specialist, conducted a security inspection of UBSO on 20 April. All observatory security procedures were found to be in order.

A copy of the Geotech Standard Practices Procedures and a UBSO addendum were mailed to Mr. Robertson on 9 February.

3. EVALUATE DATA AND PROVIDE MOST EFFECTIVE OBSERVATORY POSSIBLE

3.1 MODIFICATIONS TO INSTRUMENTATION AT UBSO

3.1.1 Modified 1 kW Power Amplifier, Model 22183

The modified 1 kW Power Amplifier, Model 22183, continued to fail repeatedly during this reporting period. Most, but not all of the failures occurred during adjustments to the timing system. In March, UBSO personnel installed a switch to allow the power amplifier to be started with no load, and then to switch the load to the amplifier after the unit is running. This modification was only partially successful. On 23 April, the power amplifier failed and would not restart. The trouble was traced to the output power transistors, which had failed. When the unit was restarted, it was discovered that it was not necessary to reset the protector circuit, indicating that the protection circuit may be inoperative. We are awaiting the outcome of laboratory tests of newly designed modifications of the amplifier.

3.1.2 Timing System, Model 11880

From 14 April until the end of the reporting period, the Timing System, Model 11880, behaved erratically. On some occasions, the timing system skipped several hundred milliseconds, and at other times the system exhibited a very fast drift rate. In our opinion, malfunctioning of a phasing transformer in the strobe unit is the cause of this erratic behavior.

On 24 April, the spare phasing transformer was sent to our Garland laboratory to be installed in our spare strobe unit. The modified strobe unit is scheduled to be returned to UBSO by early May.

3.2 ADDITIONS TO INSTRUMENTATION AT UBSO

3.2.1 Paper-Tape Punching Machine for Preparing Routine Messages

In order to reduce the number of errors in messages transmitted to the Coast and Geodetic Survey, we investigated the feasibility of preparing the message on punched paper tape at UBSO so that the Western Union Agent in Vernal could transmit the message without an intermediate manual transcription. The Western Union Regional Supervisor in Salt Lake City, Mr. Walter May, agreed to install the necessary punched paper-tape reading equipment in Western Union's Vernal office if we would acquire the paper tape punching machine to be installed at UBSO. We sent a list of the necessary equipment to the General Services Administration (GSA) office in Salt Lake City so that they could search their inventory for the needed surplus equipment. The GSA informed us that it was unlikely that we would find the equipment we need in their surplus inventory because military agencies screen all surplus equipment lists before the equipment is transferred to GSA. The GSA recommended that we submit our request through our Project Officer. On 10 April, we submitted our request to the Project Officer. As of the end of the reporting period, Western Union had installed the necessary paper-tape reading machine in its Vernal office, and we were awaiting further word concerning our request for surplus paper tape punching equipment for installation at UBSO.

3.2.2 Long-Period Cable Trench

In April, a cable trench from the central recording building to the 50-foot underground long-period vault was dug by a local contractor. UBSO personnel laid 4 lengths of multiconductor cable and 2 lengths of spiral-four cable in the trench and backfilled the excavation. The cables were not connected because we expect to ship the new advanced long-period seismometers to UBSO during the first week in May.

4. TRANSMIT DAILY MESSAGES TO THE COAST AND GEODETIC SURVEY

The arrival time, period, and amplitude measurements for events recorded at UBSO were reported daily to the Director of the Coast and Geodetic Survey (C&GS) in Washington, D. C. The number of events, by type,

reported by UBSO during each month in this reporting period is shown in table 6. The total number of events recorded by the observatory, the number of epicenters determined by the C&GS and reported in the "Earthquake Data Report," and the percent of the hypocenters in which UBSO data were utilized are given in table 7 for November and December 1966. Lists of more recent epicenters have not been completed by the C&GS.

UBSO received permission of the Project Officer to send the daily message to the C&GS on the day following the date the data were recorded, if necessary. As of the end of the reporting period, it has not been necessary to delay the message transmittal until the following day.

5. PUBLISH MONTHLY EARTHQUAKE BULLETIN

5.1 BULLETIN STATUS

Data from UBSO were combined with data from BMSO, CPSO, TFSO, and WMSO and published in a multistation earthquake bulletin. The bulletins for September, October, November, and December 1966 were published and distributed during the reporting period. The January 1967 data were received on 20 April with many errors caused by computer malfunction. Publication of the January bulletin was therefore delayed, awaiting reprocessing of the data. Raw data for February and March were keypunched, transcribed onto magnetic tape, and sent to SDL for processing. Keypunching of the April raw data was about 25 percent complete at the end of the reporting period.

5.2 REVISED BULLETIN DISTRIBUTION LIST

In order to determine the general uses being made of observatory bulletin data and to update our bulletin distribution list, a questionnaire was sent in early January 1967 to each of the 73 recipients of the five-station earthquake bulletin. To date, 55 replies have been received. Of these,two respondents indicated that they no longer wish to receive the bulletin and 21 indicated a change of address. Thirty of the respondents indicated they had used bulletin data in past studies, 32 are using bulletin data in present studies, and 37 plan to use bulletin data in future studies.

Table 6. Number of earthquakes reported to the C&GS during February, March, and April 1967

	Local	Near Regional	Regional	Teleseismic	Total
February	35	366	25	1139	1565
March	25	342	30	1351	1748
April	22	444	29	1188	1683

Table 7. Percentage of hypocenters reported to the C&GS "Earthquake Data Report" for which UBSO data were used

	Events reported by UBSO	Hypocenters reported by C&GS	Percentage of C&GS events utilizing UBSO data
November 1966	1631	365	73.5
December 1966	1584	320	71.3

6. MAINTAIN UBSO FACILITIES

6.1 AIR-CONDITIONING SYSTEM

The Amperite time-delay relay in the air-conditioning system exploded on 5 April, destroying the resistor and capacitor in the unit. Because we had no replacements, UBSO personnel bypassed the relay. The condenser fan is presently running continuously, regardless of the demand for cooling.

The air-conditioning system at UBSO is presently overloaded because of increased heat dissipation caused by equipment added since installation of the observatory and because of inadequacies in the initial design of the system. Therefore, modifications to the air-conditioning system are necessary to assure reliable operation of the observatory. An estimate for needed modifications and repairs was obtained from Automatic Systems Co., Provo, Utah, in March. Approval of the Project Officer to have the recommended work done was received on 24 April. We expect that installation will be started about 10 May.

6.2 SCRAP CABLE FROM THE VERTICAL ARRAY

An inventory of scrap cable from the vertical array was taken on 22 March. There are 11 coils of cable ranging in length from 500 to 700 feet and 8 coils that are made up of short pieces and junk cable.

6.3 ARRAY CLEANUP

On 27 and 28 March, UBSO personnel collected all empty spiral-four reels in the array area and stored them. While the backhoe was on site to dig the long-period cable trench, we dug a new garbage pit, spread the gravel in the parking lot, and installed a new culvert in the compound driveway.

6.4 LINE POWER STABILITY

On 3 April, Moon Lake Electric Association installed a capacitor across the power lines to the observatory in an attempt to eliminate voltage fluctuations. This addition did not improve the stability of the line power.

7. MAINTAIN UBSO EQUIPMENT

7.1 FLOODING OF DEVELOCORDERS

Two methods of controlling the slime buildup in the Develocorders have been tested during this reporting period. Develocorders 2 and 4 were treated with Dowicide-G, and Develocorders 1, 3, and 5 were treated with Algi-Go tablets. Develocorder 6 was not treated, to serve as a control. Both the Dowicide-G and the Algi-Go tablets proved to be highly effective in reducing the rate of slime buildup. However, on several occasions, the Algi-Go tablets clogged the drain valve from the supply tank. The tablets were put in tobacco sacks to control the sediment. No Develocorder floods due to slime buildup occurred during the last month of this reporting period.

7.2 S&E VOLTAGE REGULATOR

The S&E voltage regulator became inoperative on 28 March. The trouble was traced to a blown diode. No data were lost as a result of this failure.

7.3 AMPEX TAPE RECORDER (Tape Recorder No. 4)

A new set of record and playback heads for the Ampex tape recorder was received and installed on 19 April. The old set of heads was returned to Garland the same day. The new heads have greatly improved the quality of the seismograms recorded by this tape recorder; however, there is still some buckling of the tape as it passes over the capstan drive roller.

7.4 MAGNETIC-TAPE RECORDER 3

Magnetic-tape recorder 3 was found inoperative on 22 April. Inspection of the unit disclosed that the cooling fan for the top bank of oscillators was running erratically. A temporary cooling system was improvised to serve until a new fan can be obtained. On 23 April, magnetic-tape recorder 3 became inoperative again. The trouble was traced to a bad transistor in the power supply to the top bank of oscillators.

7.5 WINCH REPAIR

In preparation for the repair operation on the vertical array, scheduled for mid-May, both winches were inspected and checked for proper operation. The throw-out bearing arm on the small winch was found to be broken. The entire clutch assembly was replaced with the spare unit.

8. INSTRUMENT EVALUATION

8.1 EVALUATION OF VERTICAL ARRAY

8.1.1 Repairs to Vertical Array

On 2 April, DH1 became inoperative. Two sections of spiral-four cable were found to be shorted and were replaced. On 4 April, DH4 became inoperative. The trouble was traced to the fuse box at the winch, where a terminal block had come loose and shorted the fuse. Repairs were made and the system returned to operation.

8.1.2 Malfunction of DH2 and DH3

The second and third deepest elements (DH2 and DH3) of the vertical array continued to drift to the stops during this reporting period. The second deepest element (DH2) became progressively more unreliable; consequently, on 13 March, recording of the output of DH2 was terminated. Therefore, subsequent to 13 March, those MAP II channels which use data from DH2 were not operating as programmed.

8.1.3 "G" Measurements on Elements of Vertical Array

Motor constant ("G") measurements performed on elements of the vertical array during the reporting period are listed in table 8. The weight-lift unit in DH2 was inoperative throughout the reporting period, making "G" measurements on this seismometer impossible.

Table 8. Motor constant ("G") measurements on elements of the vertical array

	12 Feb	4 March	12 March	2 April	15 April
DH1	0.646	0.645	0.662	0.653	0.677
DH2	-----	-----	-----	-----	-----
DH3	0.256	0.267	0.244	0.255	0.244
DH4	0.708	0.724	0.722	0.702	0.710
DH5	0.603	0.606	0.607	0.592	0.607
DH6	0.619	0.606	0.612	0.599	0.620

8.1.4 Evaluation of Data Recorded by Vertical Array

Power spectra for each element and coherences for each pair of elements of the vertical array were computed for one signal and one noise sample during the reporting period. Evaluation of these data was in progress at the end of the reporting period.

8.1.5 Planned Repairs and Modifications to Elements of Vertical Array

If the vertical array is to become an effective system, it will be necessary to pull the array from the deep hole and repair the seismometers. In addition, the frequency responses of the elements of the vertical array, as presently operated, are far from optimum.

We plan to remove the vertical array from the deep hole about the middle of May. We will make necessary repairs to the elements of the array and adjust their frequency responses to provide greater attenuation of both the high-frequency noise and low-frequency microseisms which currently limit the capability of the vertical array. When repairs and adjustments are completed, we will reinstall the vertical array in the deep hole and operate the system routinely.

8.2 EVALUATION OF UNDERGROUND LONG-PERIOD VAULT

8.2.1 Surface Long-Period Horizontal Seismometer

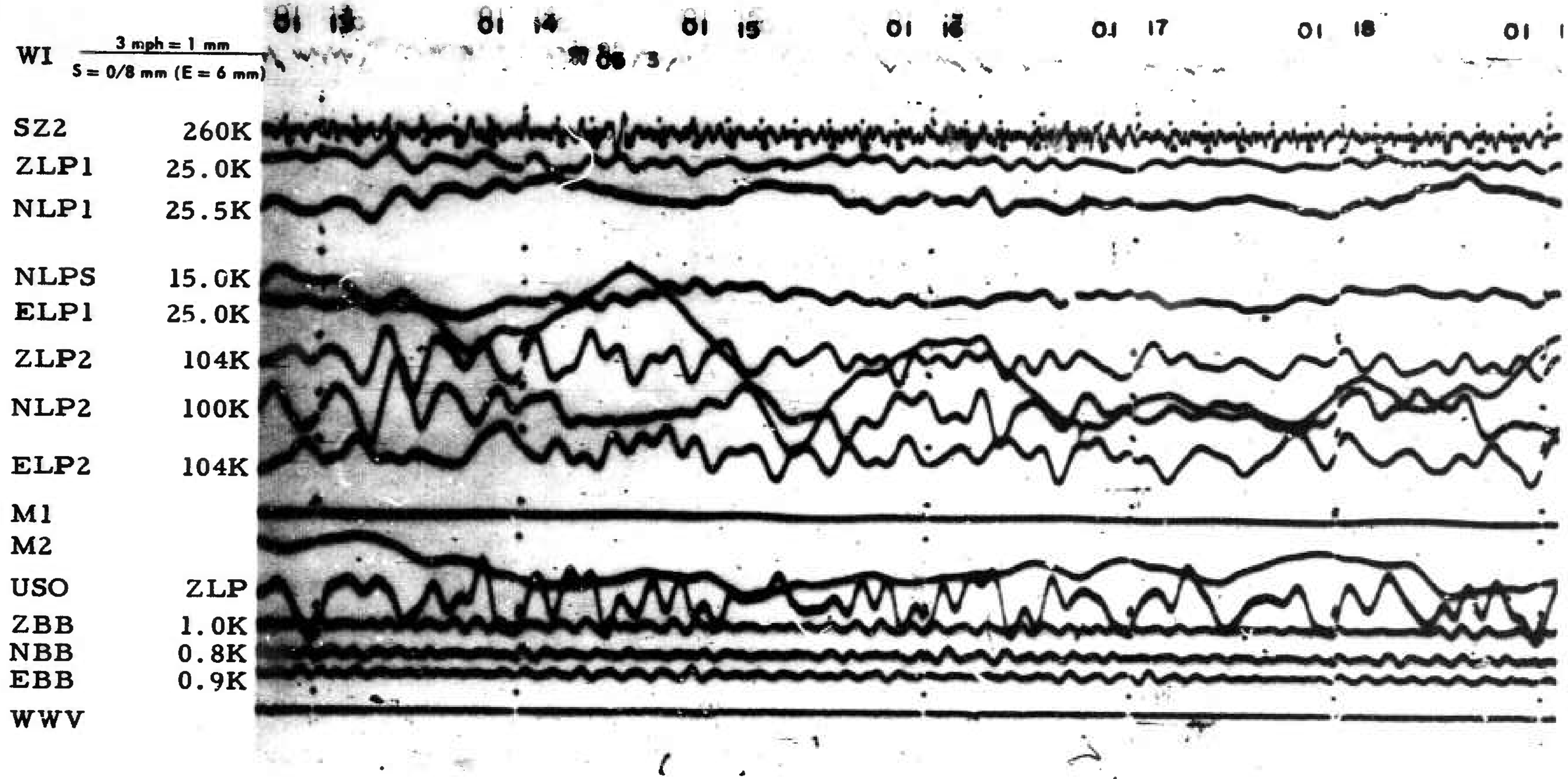
Recording of the output of the long-period horizontal seismometer (NLPS) in the surface vault adjacent to the 50-foot long-period vault was terminated on 24 February in preparation for the installation of the new advanced long-period seismometers in the underground vault.

8.2.2 New Long-Period Seismometers

The 1 vertical and 2 horizontal advanced long-period seismometers to be installed in the 50-foot underground vault were shipped to UBSO from Garland on 28 April.

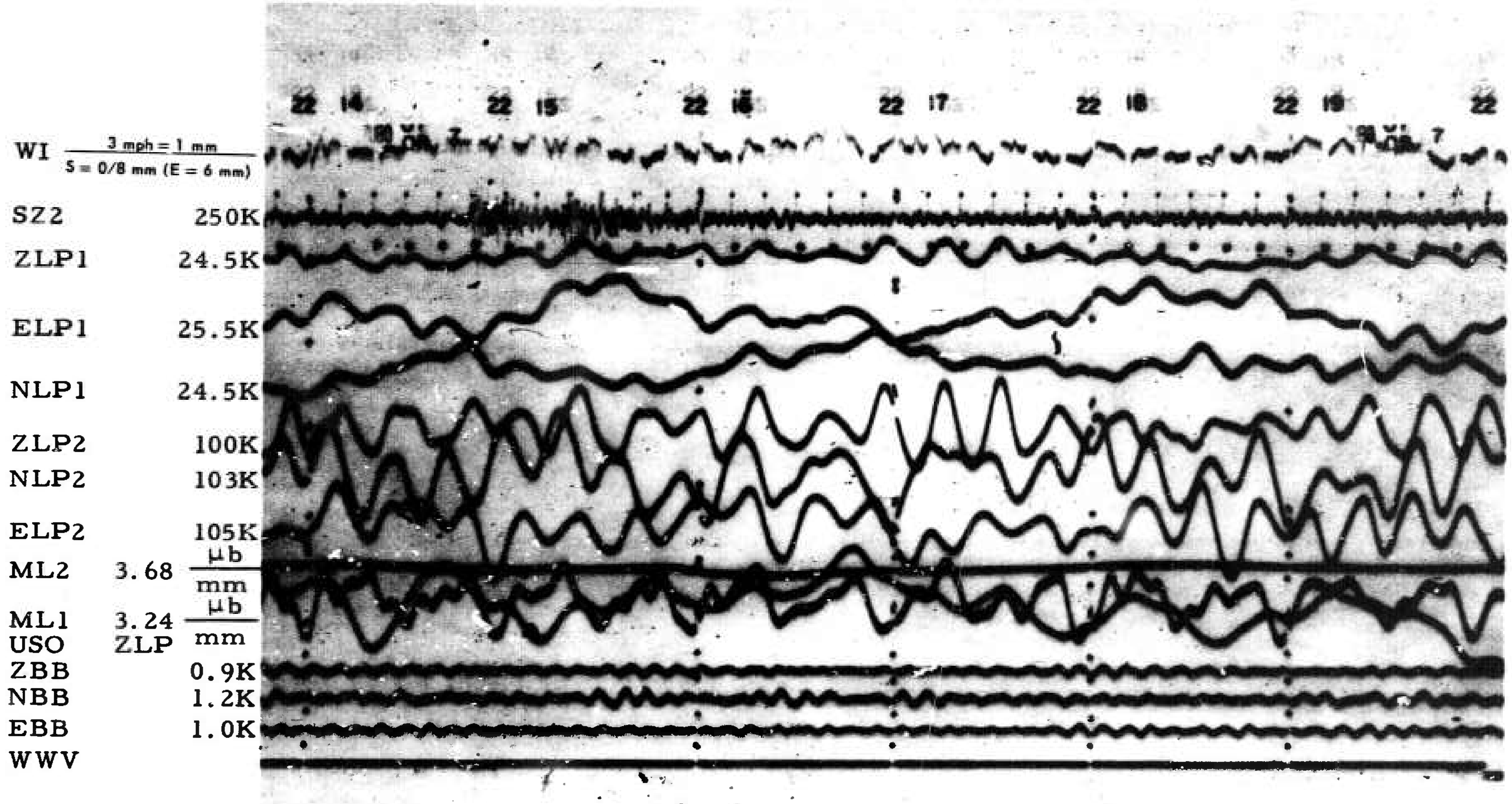
8.2.3 Long-Period Noise Associated with High Wind

Examples of noise recorded by the long-period seismographs during periods of high wind are presented in figures 3 through 6. Figure 3 shows a comparison of the response of the surface long-period horizontal seismograph (NLPS) with the responses of the long-period horizontal seismographs (NLP1 and NLP2) located in the underground vault to pressure changes associated with high wind. The NLPS seismograph shows a much greater response to wind-induced pressure changes than do either NLP1 or NLP2.



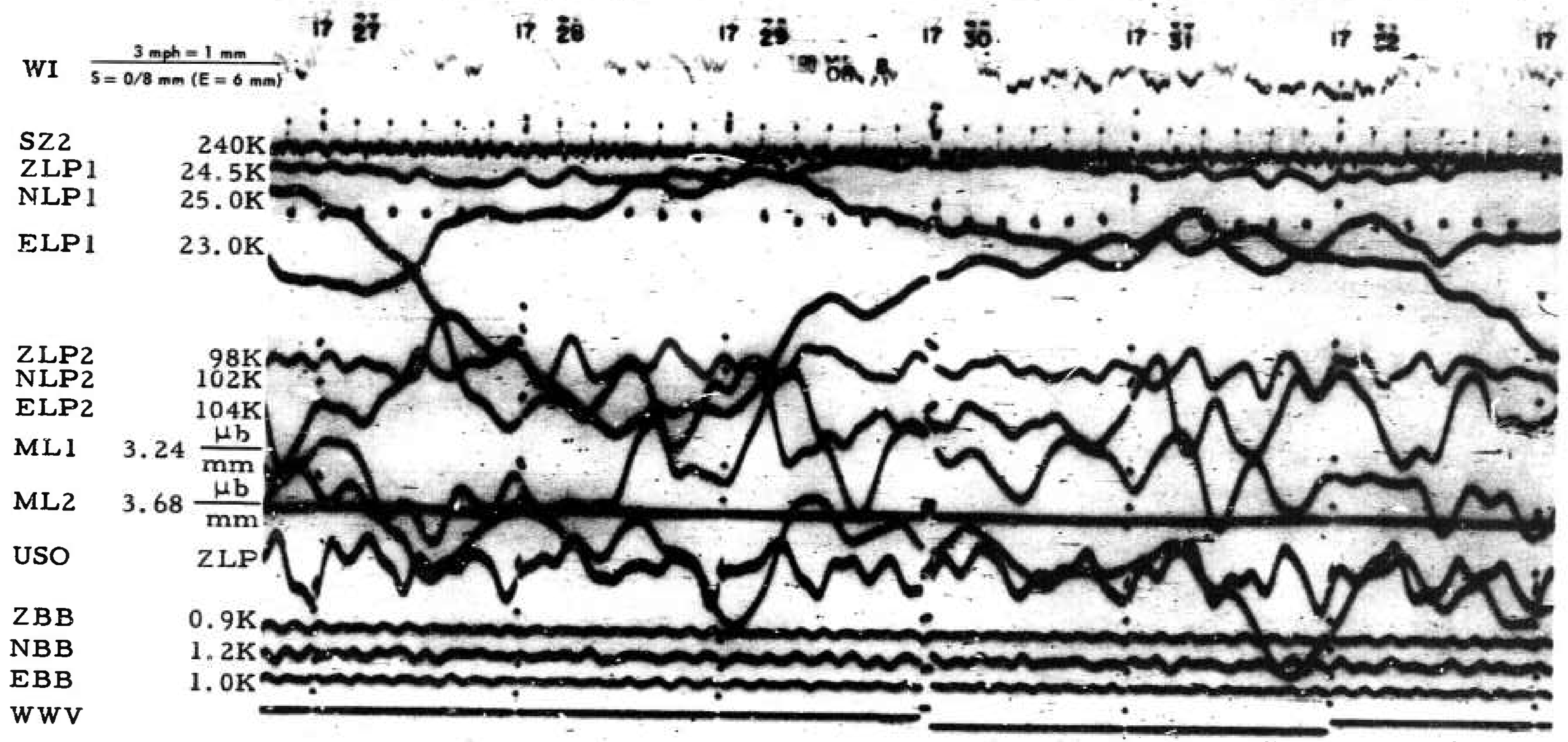
UBSO
22 February 1967
Run 053
Data Group 5066

Figure 3. Comparison of response of horizontal long-period seismometer in surface vault (NLPS) to responses of long-period seismometers in underground vault under conditions of high wind. (X10 enlargement of 16 millimeter film)



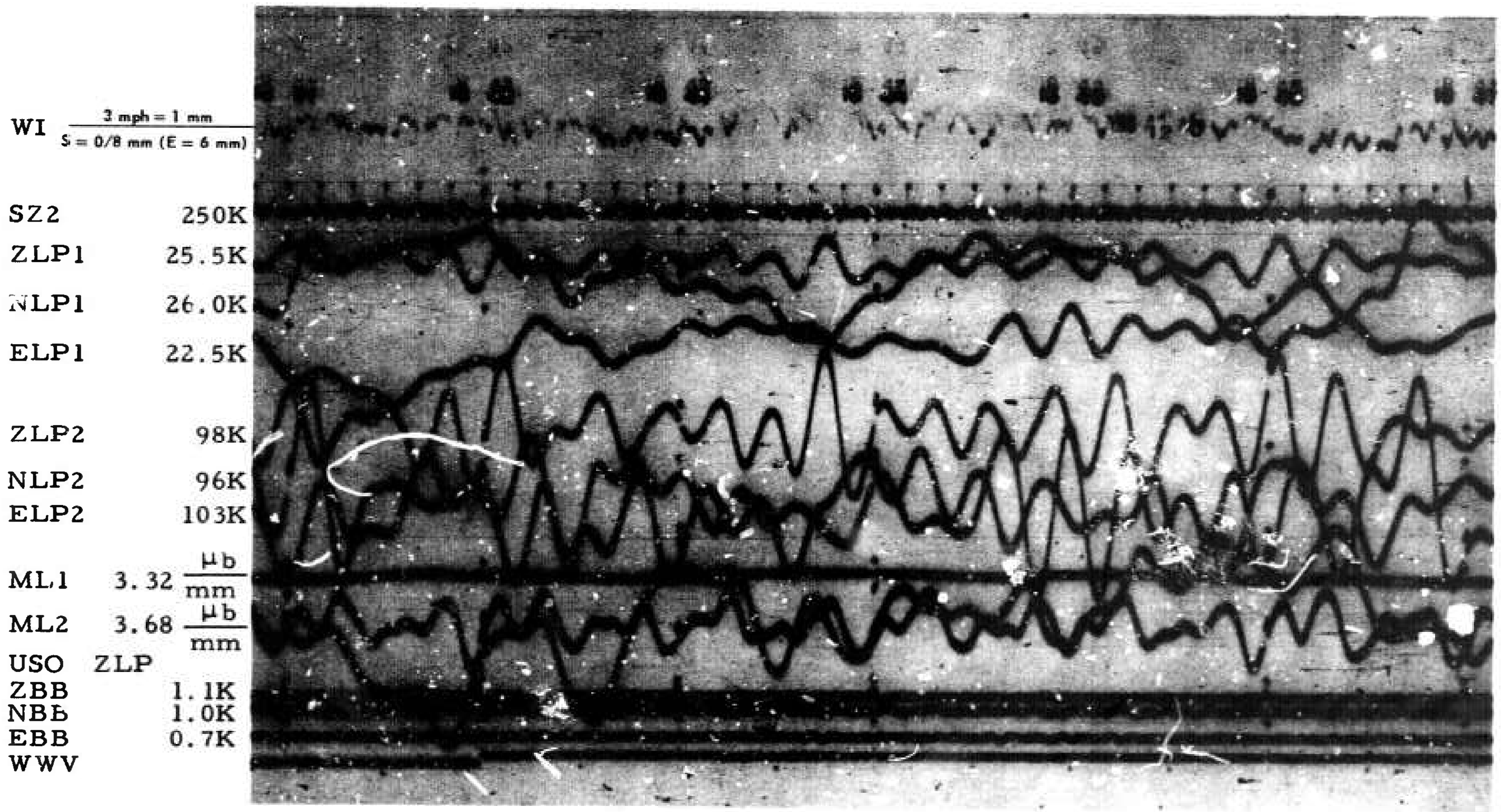
UBSO
28 March 1967
Run 087
Data Group 5074

Figure 4. Comparison of responses of broad-response, long-period seismographs (ZLP1, NLP1, and ELP1) to responses of narrow-response, long-period seismographs (ZLP2, NLP2, and ELP2) to wind-induced pressure changes. (X10 enlargement of 16 millimeter film)



UBSO
29 March 1967
Run 088
Data Group 5074

Figure 5. Comparison of responses of broad-response, long-period seismographs (ZLP1, NLP1, and ELP1) to responses of narrow-response, long-period seismographs (ZLP2, NLP2, and ELP2) to wind-induced pressure changes. (X10 enlargement of 16 millimeter film)



UBSO
30 April 1967
Run 120
Data Group 5074

Figure 6. Comparison of responses of broad-response, long-period seismographs (ZLP1, NLP1, and ELP1) to responses of narrow-response, long-period seismographs (ZLP2, NLP2, and ELP2) to wind-induced pressure change. (X10 enlargement of 16-millimeter film)

Note that NLPS was operating at a gain of only 15K compared to 25.5K for NLP1 and 100K for NLP2.

Figures 4 through 6 show a comparison of the responses of the broad-response seismographs (ZLP1, NLP1, and ELP1) to the responses of the narrow-response seismographs (ZLP2, NLP2, and ELP2) to wind-induced pressure changes. In all cases, the narrow-response seismographs are much less noisy than are the broad-response systems, and the vertical seismographs of each system are much less noisy than are the horizontal seismographs of the corresponding system.

8.3 TECHNICAL ASSISTANCE AND MONITOR OF SANDIA'S USO

Monitoring of the Sandia Unmanned Seismological Observatory (USO) continued throughout the reporting period. From 21 February to 23 March, the USO-East Short-Period (ESP) seismograph operated with fluctuating magnification and with no indication of the changing magnification being given by the automatic gain control (AGC) code. Sandia representatives replaced the amplifier in the USO-ESP seismograph on 23 March. On 24 March, the USO-ESP seismograph became intermittently inoperative. On 26 March, all USO seismographs became inoperative, exhibiting large dc offsets. Sandia personnel arrived at UBSO on 28 March and discovered that their tape recorder was inoperative because of a blown fuse. The fuse was replaced and the tape recorder returned to operation. At this time, Sandia personnel informed us that the operational problems experienced by the USO-ESP were not evident on the USO magnetic-tape seismograms, indicating that the intermittent short causing erratic operation of USO-ESP is located in the line from the USO tape recorder to the Develocorder. Efforts by UBSO personnel to locate the source of the trouble included interchanging the output isolation amplifiers of the USO-ESP and USO-time channels, replacing the data control module 5 which is used for the USO-ESP and USO-time channels, interchanging the data lines of the USO-ESP and USO-time channels, and completely interchanging the circuitry of the USO-ESP and USO-time channels from the USO junction box to the Develocorder galvanometers. The USO-ESP continued to perform erratically throughout all of these tests. Because of the results of these tests and because the USO-ESP channel is being recorded properly on the USO tape recorder, the short must be located between the USO tape recorder and the junction box.

Sandia personnel were notified of the results of the tests; they plan to return to UBSO on 2 May.

9. SPECIAL INVESTIGATIONS

9.1 EVALUATION OF MAP

9.1.1 Multifrequency Relative Amplitude Responses

Multifrequency relative-amplitude responses were run on (multichannel filters) MCF1, MCF3, and MCF4 of MAP I in March. To assure accuracy of the measurements, a frequency counter was used to set the frequency being applied, and measurements were made from a Develocorder record obtained with all traces removed from the Develocorder except the trace representing the output of the MCF being calibrated. A total of 60 man-hours was required to calibrate these three channels of MAP I. Numerous values of the relative amplitudes deviated from the corresponding theoretical values by as much as 20 percent, and a few values deviated from the theoretical values by as much as 50 percent. The cause of these large deviations had not been determined at the end of the reporting period.

9.1.2 Visual S/N Comparison

A comparison of signal-to-noise ratio (S/N), based on visual measurements of signal and noise amplitudes has been made for 10 MAP systems together with SZ10 and ΣSSF for approximately 100 signals. Interpretation of these data was in progress at the end of the reporting period.

9.1.3 Visual Noise Measurements

Visual noise measurements are being made for 10 MAP systems, using the same sampling and measuring techniques that are used for the routine noise measurements from the standard UBSO seismograms. Measurements for 1 month's data had been completed at the end of the reporting period.

9.1.4 Noise Power Spectra

Power spectral density estimates for samples of noise recorded by the 6 MAP systems being recorded on magnetic tape (MCF's 4, 1, and 3 from MAP I, MCF's 11, 12, and 13 from MAP II) are being computed. Samples of 149-second duration have been selected from four conditions of noise, as follows:

a. Low microseismic noise without road noise;

b. Low microseismic noise with road noise;

c. Intermediate microseismic noise without road noise;

d. High microseismic noise without road noise.

9.1.5 Detection Capability Comparison

A comparison is being made of the detection capabilities of three systems, defined as follows:

System 1: SZ1-10, ΣSS, ΣSSF;

System 2: MAP I plus Z1-Z3, Z5, Z6, Z10;

System 3: those channels of MAP II which use only elements of the vertical array plus DH1-6, ΣDH, ΣDHF.

An experienced analyst is independently reading seismograms recorded on each system and grading each subsystem as to how well it detected each event recorded by the given system. These data will be used to determine the relative importance of each subsystem's contribution to the system of which it is a part and to evaluate the overall detection capabilities of systems 2 and 3 relative to system 1.

9.2 ARRIVAL TIME RESIDUAL STUDY

During the reporting period, a study of accuracy of arrival time determination, signal detectability, and accuracy of determination of the direction of first motion as a function of signal-to-noise ratio (S/N) was conducted. The data used in this study were taken from the analyses of the synthesized seismograms prepared for the detection capability study, reported in Geotech Technical Report 66-1, Estimates of the Detection Capability of Four VELA-Uniform Seismological Observatories. For the arrival-time residual study, data for one signal (signal 9) occurring in 13 noise types were processed to yield percent detected, percent correct first-motion determinations, and arrival-time residual (analyst pick time-signal occurrence time) frequency distributions as a function of S/N for each noise type and for all noise types combined. Four cases were considered:

a. Four individual vertical seismograms, a summation seismogram, and a filtered summation seismogram (system 3); S/N determined from an individual vertical seismogram;

b. System 3: S/N determined from the summation seismogram;

c. Four individual vertical seismograms and a summation seismogram (system 2); S/N determined from an individual seismogram;

d. System 2: S/N determined from the summation seismogram.

For case (a) and for all noise types combined, 88 percent of the signal occurrences with S/N greater than 1.0 were detected, and 96 percent of the signal occurrences with S/N greater than 2.0 were detected. For the same conditions and for S/N less than about 8.0, the percent of correct first motion determinations did not increase significantly with increasing S/N. For case (a) and for all noise types combined, the variance of the arrival-time residuals decreased with increasing S/N.

We expect to submit a report on the results of this study to the Project Officer on 1 May 1967.

9.3 SIGNAL CLASSIFICATION STUDY

Significant progress has been made during this reporting period in the study (which was begun under Project VT/5055) designed to develop a system for classifying teleseismic P-wave signals on the basis of their visual characteristics. A preliminary classification system has been developed and applied to approximately 300 teleseismic P-wave signals with magnitudes equal to or greater than 5.0. The classified signals have been recorded on a composite 16-millimeter film and a set of instructions for applying the classification system has been written.

We plan to have analysts at TFSO and UBSO independently classify the signals recorded on the composite film. If results obtained by different analysts are not consistent, we will modify the classification scheme until consistent results are obtained. The results of this study will also be analyzed to determine if the visual characters involved in the classification scheme are independent. If some of the characters turn out to be dependent on the others, the classification scheme will be modified until an independent set of characters is found.

When a satisfactory classification scheme has been developed, we will investigate the effect of variations in signal-to-noise ratio on the categories into which signals are classified.

9.4 LONG-PERIOD NOISE RMS LEVELS RECORDED AT TFSO, UBSO, AND WMSO

Values of rms level of a 40-minute sample of noise recorded on each component of the long-period seismographs at TFSO, UBSO, and WMSO during the reporting interval were calculated. The sample was randomly selected from periods in which no nonseismic noise was present. The rms values were calculated from the time domain signals, with no frequency filtering other than that imposed by the respective seismographs. The frequency responses, shown in figures 7 through 9, are different for the different observatories and even for different components at a given observatory. Therefore, the differences in frequency response of the different seismographs must be considered when comparing the rms values of the different systems. The calculated rms values are presented in table 9.

Table 9. Rms values of randomly selected long-period noise samples recorded at TFSO, UBSO, and WMSO

	Run No.	Date	Seismograph	rms (m μ)
TFSO	56	25 Feb. 67	ZLP	38.0
			NLP	32.9
			ELP	26.0
TFSO	93	3 April 67	ZLP	23.5
			NLP	21.1
			ELP	14.1
UBSO	95	5 April 67	ZLP1	8.4
			NLP1	12.6
			ELP1	9.5
WMSO	99	9 April 67	ZLP	24.4
			NLP	39.1
			ELP	32.5

9.5 LONG-PERIOD ARRAY INVESTIGATION

During the reporting period, we investigated the feasibility and desirability of installing an array of three-component long-period seismographs at UBSO. We investigated the possibility of transmitting data from the seismometers to the central recording building by means of existing telephone lines instead of by means of spiral-four cable and investigated several possible array configurations. When our investigation is complete, we will submit a long-period array recommendation to the Project Officer.

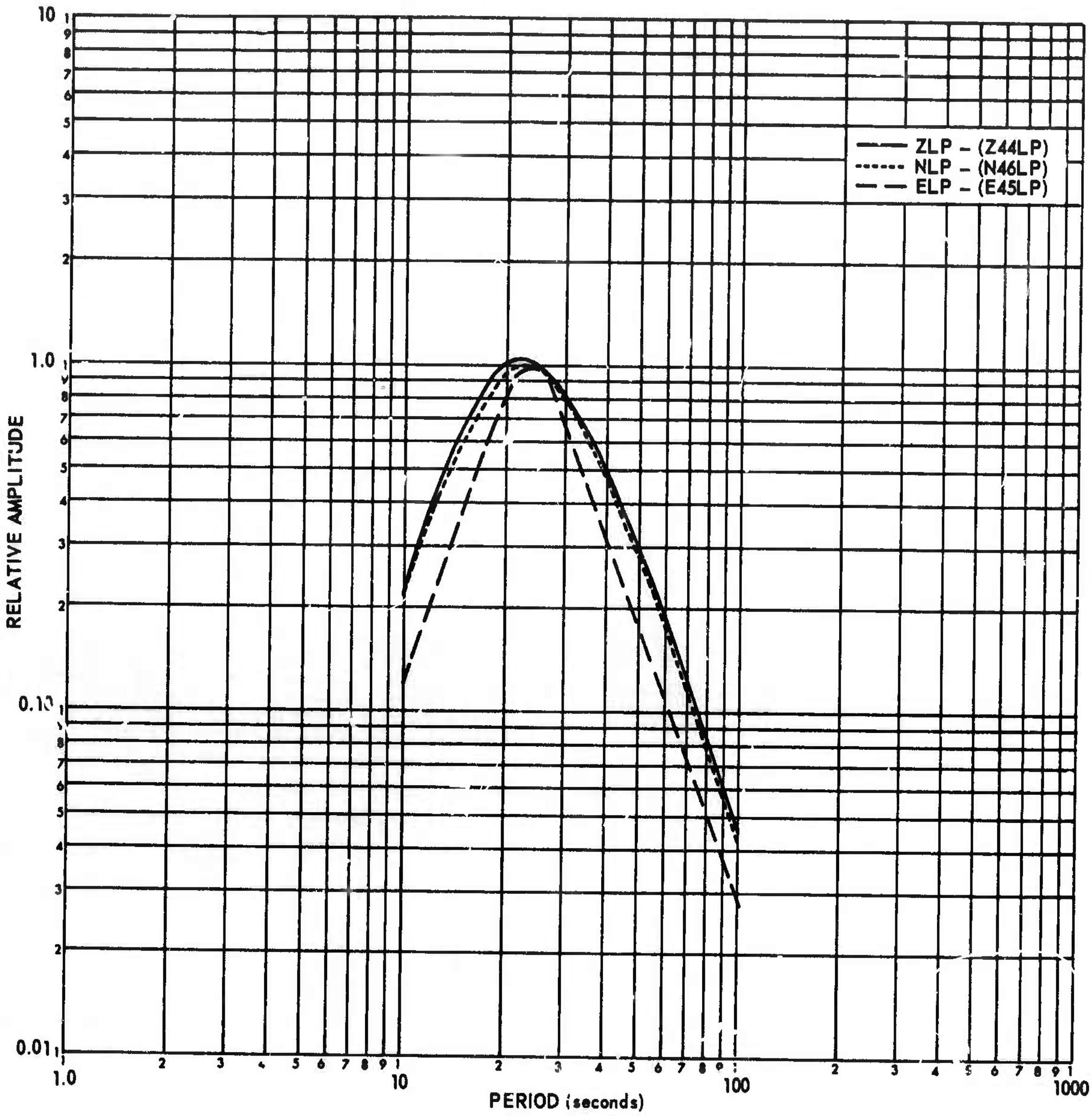


Figure 7. Normalized frequency responses of TFSO long-period seismographs

G 2712

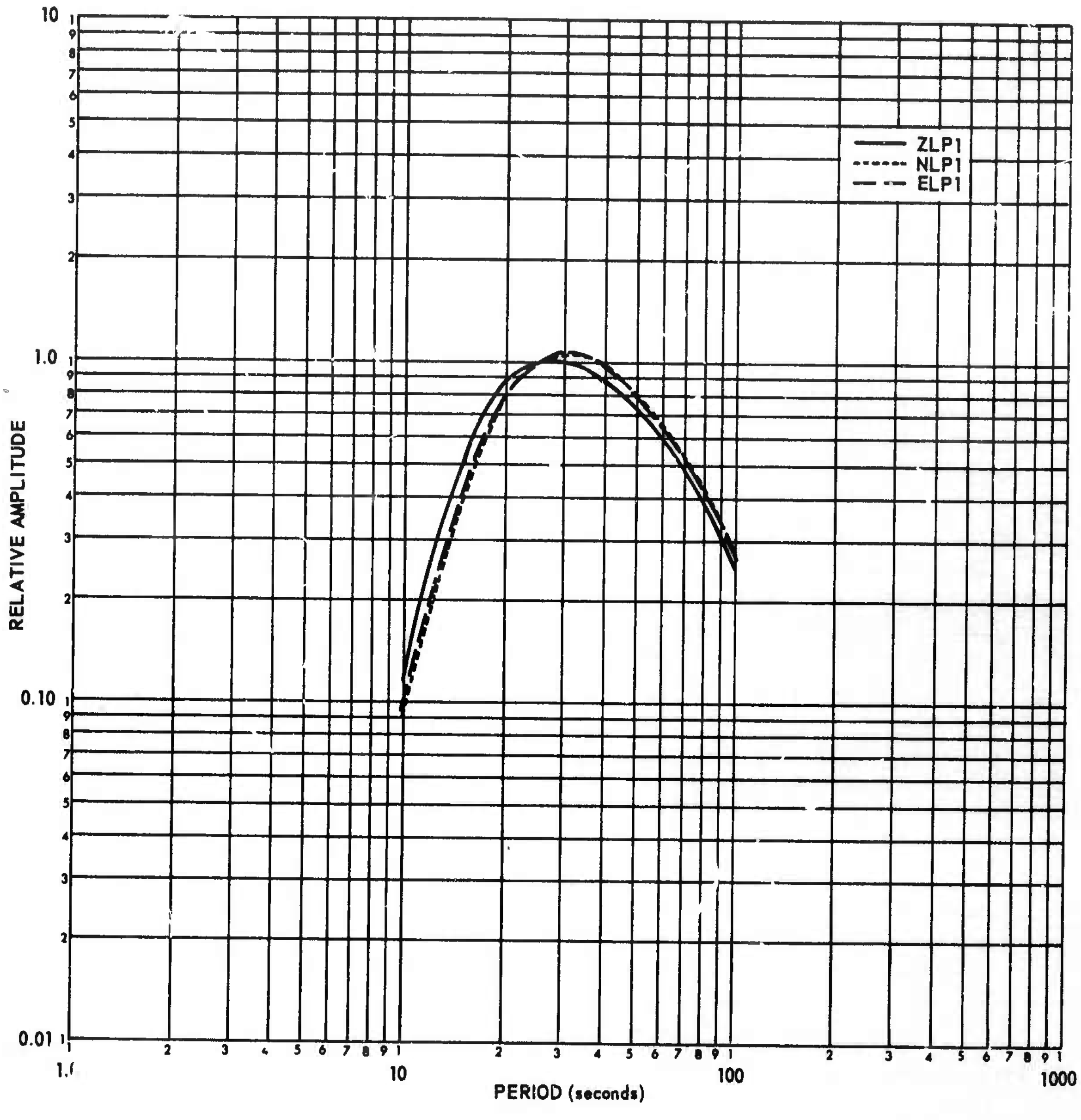


Figure 8. Normalized frequency responses of UBSO long-period seismographs

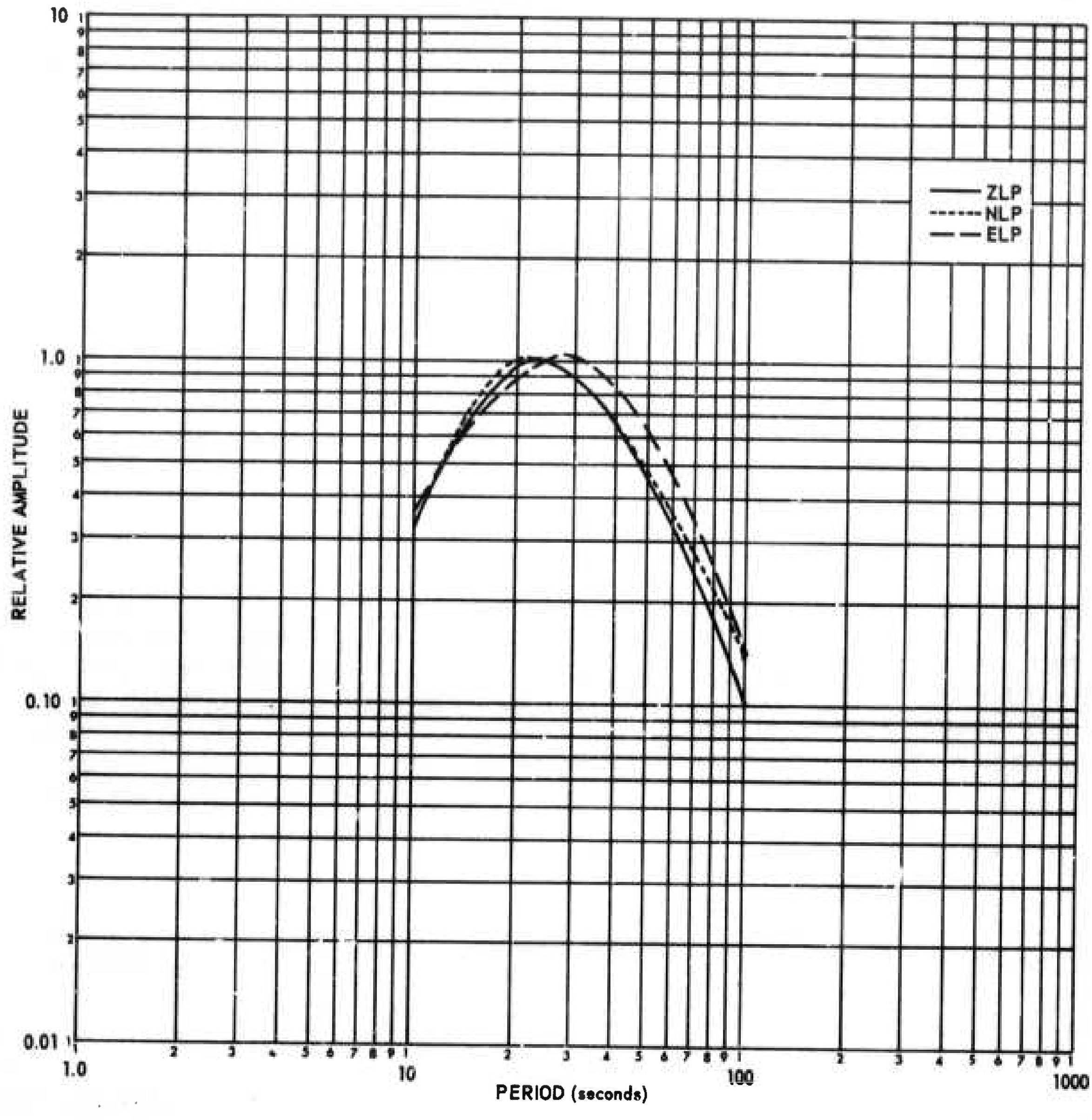


Figure 9. Normalized frequency responses of WMSO long-period seismographs

G 2714

9.6 ROUTINE NOISE MEASUREMENTS

Measurements of ambient noise in the 0.4- to 1.4-second period range are made daily at UBSO. Data are processed in Garland, and monthly cumulative probability curves of trace amplitudes and ground displacement are published. Noise data are reported from the Z10, SZ10, ΣT, ΣST, ΣTF, and ΣSTF seismograms. Noise curves for December 1966 through February 1967 were sent to the Project Officer during this reporting period.

10. PROVIDE OBSERVATORY FACILITIES AND ASSISTANCE TO OTHER ORGANIZATIONS

10.1 NASA SONIC BOOM STUDY

The sonic boom flights over UBSO took place on 2 March, as scheduled. By 7 March, all personnel taking part in the sonic boom study had departed UBSO.

10.2 DATA SENT TO THE UNIVERSITY OF UTAH

With the Project Officer's approval, arrival time, amplitude, and period data for blasts at the Bingham mine which occurred between 5 February and 25 February were sent to Dr. Kenneth Cook, University of Utah, at Dr. Cook's request.

10.3 DELETION OF MAGNETIC TAPE SHIPMENT TO C&GS, ALBUQUERQUE

At the Project Officer's request, the routine monthly shipment of degaussed magnetic tape to the Coast and Geodetic Survey, Albuquerque, scheduled for 15 April, was skipped. The next shipment will be made on 15 May.

10.4 SHIPMENT OF UBSO DAILY MESSAGES TO COLORADO SCHOOL OF MINES

During the reporting period, approval was received from the Project Officer to send copies of the UBSO daily message to the Colorado School of Mines. Copies of the messages will be sent weekly.

10.5 SHIPMENT OF UBSO DAILY LETTER REPORTS TO THE U.S GEOLOGICAL SURVEY

With the Project Officer's approval, copies of the UBSO daily letter reports for the period 1 November 1966 through 24 April 1967 were sent to Dr. C. B. Raleigh, U. S. Geological Survey, Menlo Park, California. Dr. Raleigh is engaged in studies of earthquake generation by the pumping of waste into deep wells for disposal, primarily in the Denver area. Future letter reports will be sent weekly to Dr. Raleigh.

10.6 VISTORS

Mr. John McDonald, Teledyne, was at UBSO from 23 February until 7 March to supervise recording of seismic effects of the sonic booms.

Messrs. A. C. Morgan and H. K. King, Teledyne, were at UBSO from 25 February until 7 March to take part in the sonic boom program.

Mr. Herb Henderson, NASA Langley Research Center, was at UBSO from 25 February until 2 March in connection with the sonic boom program. Mr. Henderson is NASA Technical Supervisor for the sonic boom program.

Messrs. G. D. Davidson, H. D. Sell, and J. N. Perkins, Philco Corp., were at UBSO from 26 February until 2 March installing equipment to monitor overpressure caused by the sonic booms.

Sandia Corporation representatives R. S. Reynolds, D. F. Davis, and G. H. Mauth were at UBSO on 23 March performing maintenance on Sandia's USO.

Mr. Royden Shurtz, Automatic Systems Co., was at UBSO on 23 March to finalize his recommendation for modifications to the UBSO air-conditioning system.

Mr. W. C. Jones, Kemper Insurance Co., inspected all pressure systems at UBSO on 24 March. No discrepancies were found.

Messrs. D. F. Davis and R. W. Dietzel, Sandia Corp., were at UBSO on 28 March, performing maintenance on the USO.

Twenty-nine students and their teacher from the sixth, seventh, and eighth grades of the Dinosaur, Colorado, school visited UBSO on 14 April.

11. REPORTS

Technical Report No. 67-10, Operatic·ı of UBSO, Quarterly Report No. 3, Project VT/6705, was mailed to the Project Officer on 21 February.

APPENDIX to TECHNICAL REPORT NO. 67-31

STATEMENT OF WORK

EXHIBIT "A"

STATEMENT OF WORK TO BE DONE

AFTAC Project Authorization No. VELA T/6705/S/ASD (32)

8 February 1966

1. Tasks:

a. Operation:

(1) Continue operation of the Uinta Basin Seismological Observatory (UBSO), normally recording data continuously.

(2) Evaluate the seismic data to determine optimum operational characteristics and make changes in the operating parameters as may be required to provide the most effective observatory possible. Addition and modification of instrumentation are within the scope of work. However, such instrument modifications and additions, data evaluation, and major parameter changes are subject to the prior approval of AFTAC.

(3) Conduct daily analysis of seismic data at the observatory and transmit daily seismic reports to the US Coast and Geodetic Survey, Wash DC 20230, using the established report format and detailed instructions.

(4) Record the results of daily analysis on magnetic tape in a format compatible with the automated bulletin program used by the Seismic Data Laboratory (SDL) in their preparation of the seismological bulletin of the VELA-UNIFORM seismological observatories. The format should be established by coordination with SDL through AFTAC. The schedule of routine shipments of these prepared magnetic tapes to SDL will be established by AFTAC.

(5) Establish quality control procedures and conduct quality control, as necessary, to assure the recording of high quality data on both magnetic tape and film. Past experience indicated that quality control review of one magnetic tape per magnetic tape recorder at the observatory each week is satisfactory unless quality control tolerances have been exceeded and the necessity of additional quality control arises. Quality control of magnetic tape should include, but need not necessarily be limited to, the following items:

(a) Completeness and accuracy of operation logs.

(b) Accuracy of observatory measurements of system noise and equivalent ground motion.

(c) Quality and completeness of voice comments.

(d) Examination of all calibrations to assure that clipping does not occur.

(e) Determination of relative phase shift on all array seismographs.

(f) Measurement of DC unbalance.

(g) Presence and accuracy of tape calibration and alignment.

(h) Check of uncompensated noise on each channel.

(i) Check of uncompensated signal-to-noise of channel 7.

(j) Check of general strength and quality of timing data derived from National Bureau of Standards Station WWV.

(k) Check of time pulse modulated 60 cps on channel 14 for adequate signal level and for presence of time pulses.

(l) Check of synchronization of digital time encoder with WWV.

(6) Provide observatory facilities, accompanying technical assistance by observatory personnel, and seismological data to requesting organizations and individuals after approval by AFTAC.

(7) Maintain, repair, protect, and preserve the facilities of the seismological observatory in good physical condition in accordance with sound industrial practice.

b. Instrument Evaluation: After approval by AFTAC, evaluate the performance characteristics of experimental or off-the-shelf equipment offering potential improvement in the performance of observatory seismograph systems. Operation and test of such instrumentation under field conditions should normally be preceded by laboratory test and evaluation.

c. Special Investigations: Conduct research investigations as approved or requested by AFTAC to obtain fundamental information which will lead to improvements in the detection capability of UBSO. These programs should take advantage of geological, meteorological, and seismological conditions at UBSO. The following special studies should be accomplished.

(1) Long term evaluation of the multiple array processor units.

(2) Installation and evaluation of a vertical array.

(3) Evaluation of the long-period vault.

(4) Provide technical assistance and monitor an unattended seismological observatory to be installed at UBSO in June 1967.

Research might pursue investigations in, but is not necessarily limited to, the following areas of interest: microseismic noise, signal characteristics, data presentation, detection threshold, and array design (surface and shallow borehole). Prior to commencing any research

EXHIBIT "A"

investigation, AFTAC approval of the proposed investigation and of a comprehensive program outline of the intended research must be obtained.

2. Approval by AFTAC will normally be provided through the project officer.

3. Reports: Provide reports in accordance with the/requirements outlined in DD Form 1423 and attachment 1 thereto.

Data

Unclassified

Security Classification

DOCUMENT CONTROL DATA - R&D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) GEOTECH, A Teledyne Company 3401 Shiloh Road Garland, Texas	2a. REPORT SECURITY CLASSIFICATION Unclassified 2b. GROUP

3. REPORT TITLE

Operation of UBSO
Quarterly Report No. 4, Project VT/6705, 1 February 1967 through 30 April 1967

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

Quarterly Report No. 4, Project VT/6705, 1 February 1967 through 30 April 1967

5. AUTHOR(S) (Last name, first name, initial)

Leichliter, B. B.

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
19 May 1967	50	

8a. CONTRACT OR GRANT NO. AF 33(657)-16563 b. PROJECT NO. VELA T/6705 c. ARPA Order No. 624 d. ARPA Program Code No. 6F10	9a. ORIGINATOR'S REPORT NUMBER(S) 9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	Advanced Research Projects Agency Nuclear Test Detection Office Washington, D. C.

13. ABSTRACT

This report described the operation of the Uinta Basin Seismological Observatory from 1 February 1967 through 30 April 1967. Modifications and additions to the observatory instrumentation are described, and tests to improve the operation of the observatory are reported. Also discussed is the status of special investigations designed to evaluate and improve the detection capability of the observatory.

DD FORM 1 JAN 64 1473

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14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Unattended Seismological Observatory Vertical Array Multichannel Array Processor Seismograph Operating Parameters						

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